

The Brattle Group

New U.S. Emission Regulations Electric Industry Impacts

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Introduction

- ◆ Talk focuses on three new or pending EPA emissions regulations that will have a large impact on the coal fleet and electric markets
- ◆ **Proposed CO₂ Emission Standard**
 - Bans new coal plants with CO₂ emissions greater than a gas CC
- ◆ **Cross-State Air Pollution Rule (CSAPR)**
 - Cap-and-trade program for NO_x and SO₂, replacing CAIR
 - Will increase production costs for coal relative to gas
 - Likely to cause modest incremental retrofits fleet-wide
 - Planned for Jan 2012 but currently stayed (now expected for 2013 at earliest)
- ◆ **Mercury and Air Toxics Standard (MATS)**
 - Requires coal and oil-fired plants to meet emissions standards by 2015 (with extensions to 2016 if needed to complete upgrades)
 - Much of the coal fleet will retire rather than make the major capital investments required to retrofit

Poor Current Economics for Coal Plants

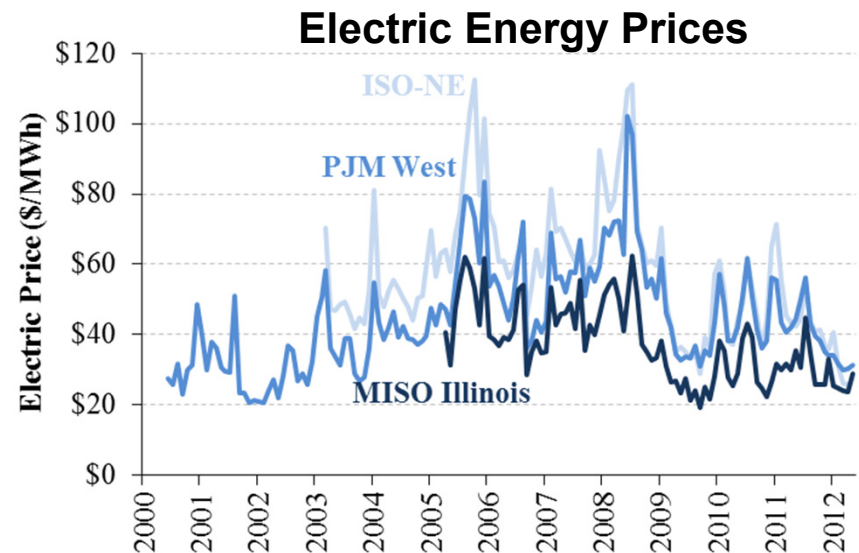
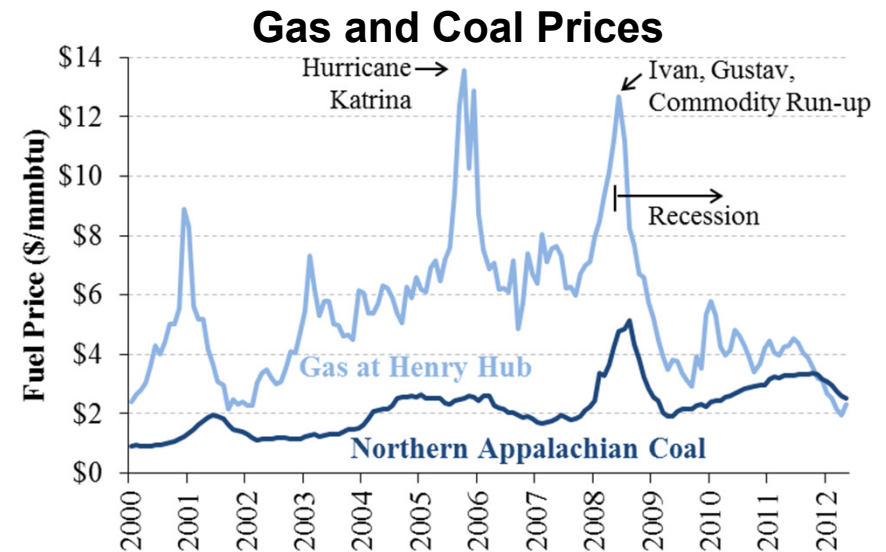
Low Gas and Electric Prices

Low Gas Price

- ◆ Gas prices have been very low since the recession started
- ◆ Historically low in the past few months (making gas cheaper than coal in some locations)
- ◆ Translates into lower electric prices because gas-fired gen sets the price in many hours

Impact on Coal

- ◆ Add low gas price to low electric demand
- ◆ Result is substantial reductions in coal generators' operating margins



Sources: Bloomberg; Ventyx Energy Velocity Suite.

Proposed CO₂ Standard

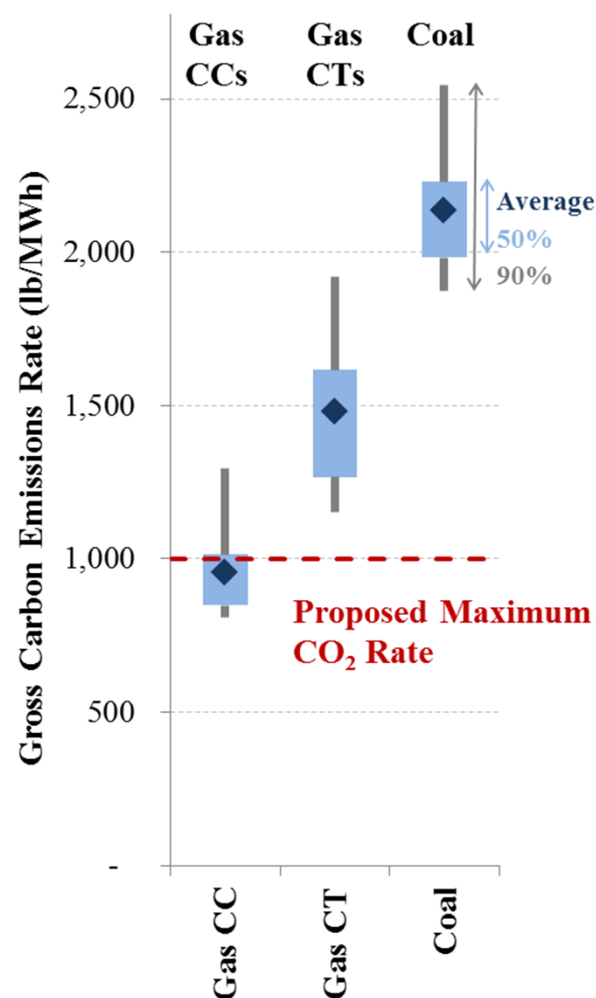
Requirements

- ◆ New units above 25 MW, beginning construction after March 2013
- ◆ Required to meet an emissions standard of 1,000 lb CO₂/MWh gross

Implications

- ◆ Effectively a ban on new coal plants
- ◆ Most existing CCs would meet the standard (especially new units)
- ◆ Gas CTs would not meet the standard (but not covered at this time)
- ◆ Economics have shifted to new gas CCs regardless, and so the standard will have less impact than it would have five years ago

CO₂ Rates of Current Fleet Compared to Proposed Standard



Sources:

<http://epa.gov/carbonpollutionstandard/pdfs/20120327factsheet.pdf>

Ventyx Energy Velocity Suite.

Cross-State Air Pollution Rule

Previous CAIR Deemed Deficient

- ◆ DC Circuit Court remanded CAIR to EPA in 2008, finding that it insufficiently addressed up-stream states' contribution to poor air quality in down-stream states
- ◆ Cap-and-trade mechanism allowed unlimited trading of SO₂ and NO_x allowances between states
- ◆ CAIR reinstituted as a transitional mechanism until EPA could replace it

CSAPR

- ◆ Cap-and-trade with restrictions on interstate trading
- ◆ States can buy allowances in excess of budget, but if they exceed a "Variability Limit" then individual plants must pay a penalty
- ◆ Variability limit is 18% for NO_x, 21% for SO₂
- ◆ Penalty for exceeding budget plus variability limit is that 2 penalty allowances (3 total) must be surrendered for excess emissions

Cross-State Air Pollution Rule

How Strict are the Pollutant Caps?

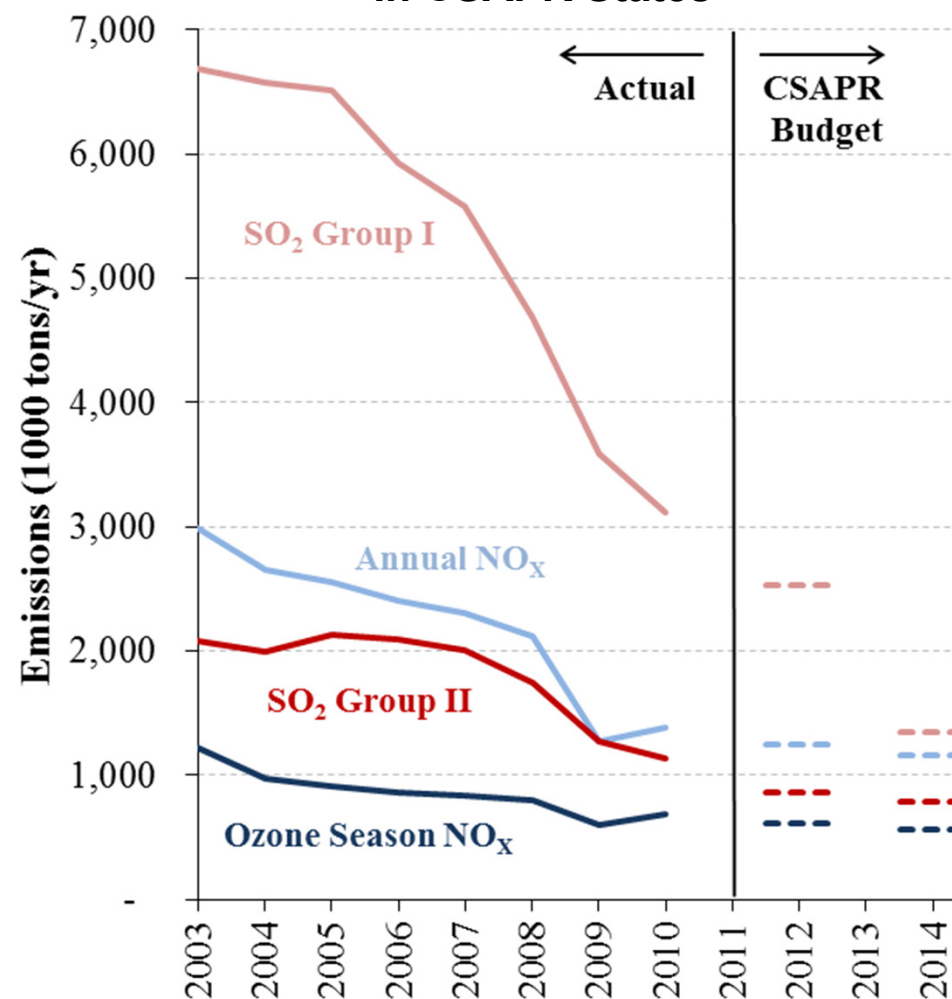
Required Reductions

- ◆ 10-24% below 2010 levels by 2012
- ◆ 16-60% below by 2014
- ◆ Impact on individual states varies widely (e.g. OH and PA budgets reduce SO₂ by more than 70% by 2014)

Compliance Options

- ◆ Fuel switching to gas (and dispatch switching to other states)
- ◆ Allowances
- ◆ Latent controls capability (controls that have not been operated)
- ◆ Controls retrofits

Historical and Budgeted Emissions In CSAPR States

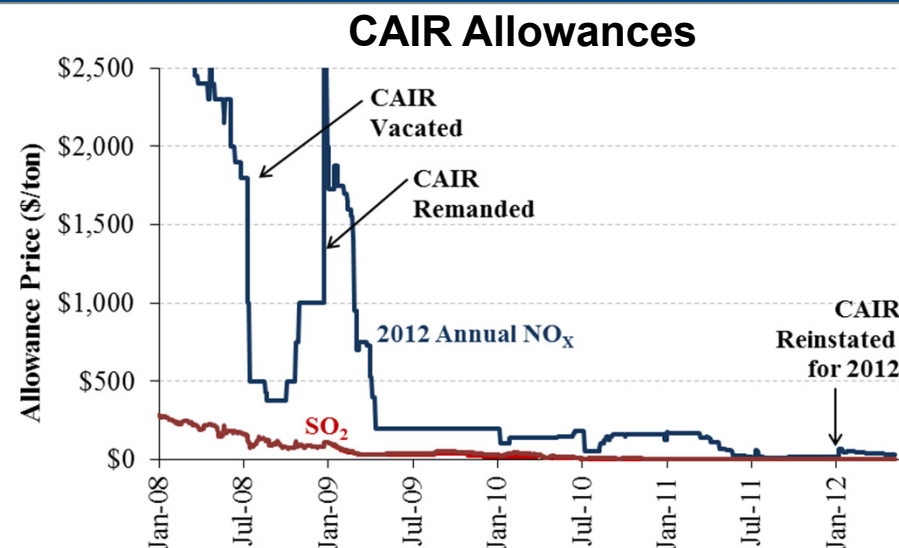


Sources: <http://www.epa.gov/airtransport/stateinfo.html>

Regulatory Limbo Reflected in Allowance Markets

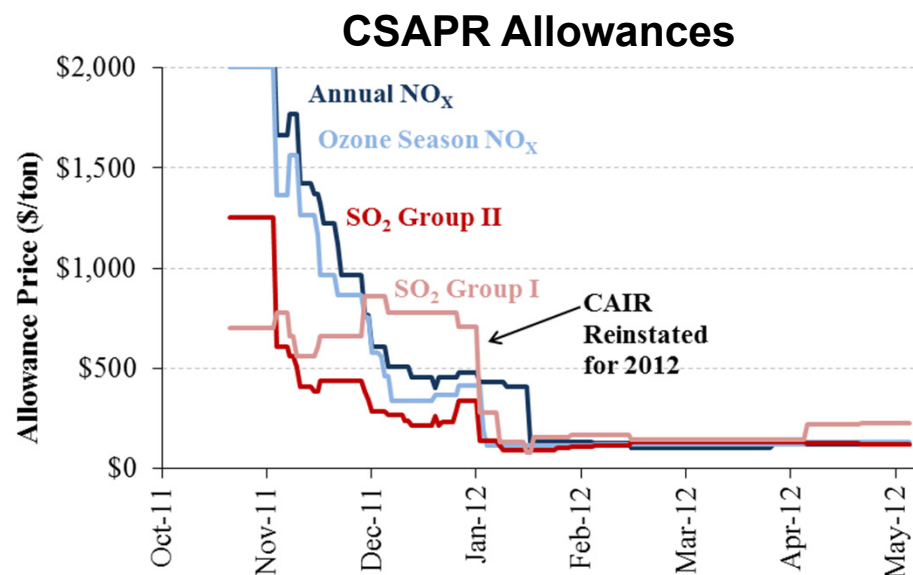
CAIR Allowances

- ◆ CAIR allowance prices dropped dramatically after CAIR was vacated in 2008 (rebounded after temporary reinstatement)
- ◆ EPA made it clear that there was no guarantee that CAIR allowances would be usable under new rule



CSAPR Allowances

- ◆ Trading started in fall 2011 in preparation for anticipated 2012 effective date (originally high prices consistently dropped)
- ◆ After CSAPR was stayed, trading was very limited (and at far reduced prices)



Mercury and Air Toxics Standards

Finalized December 2011

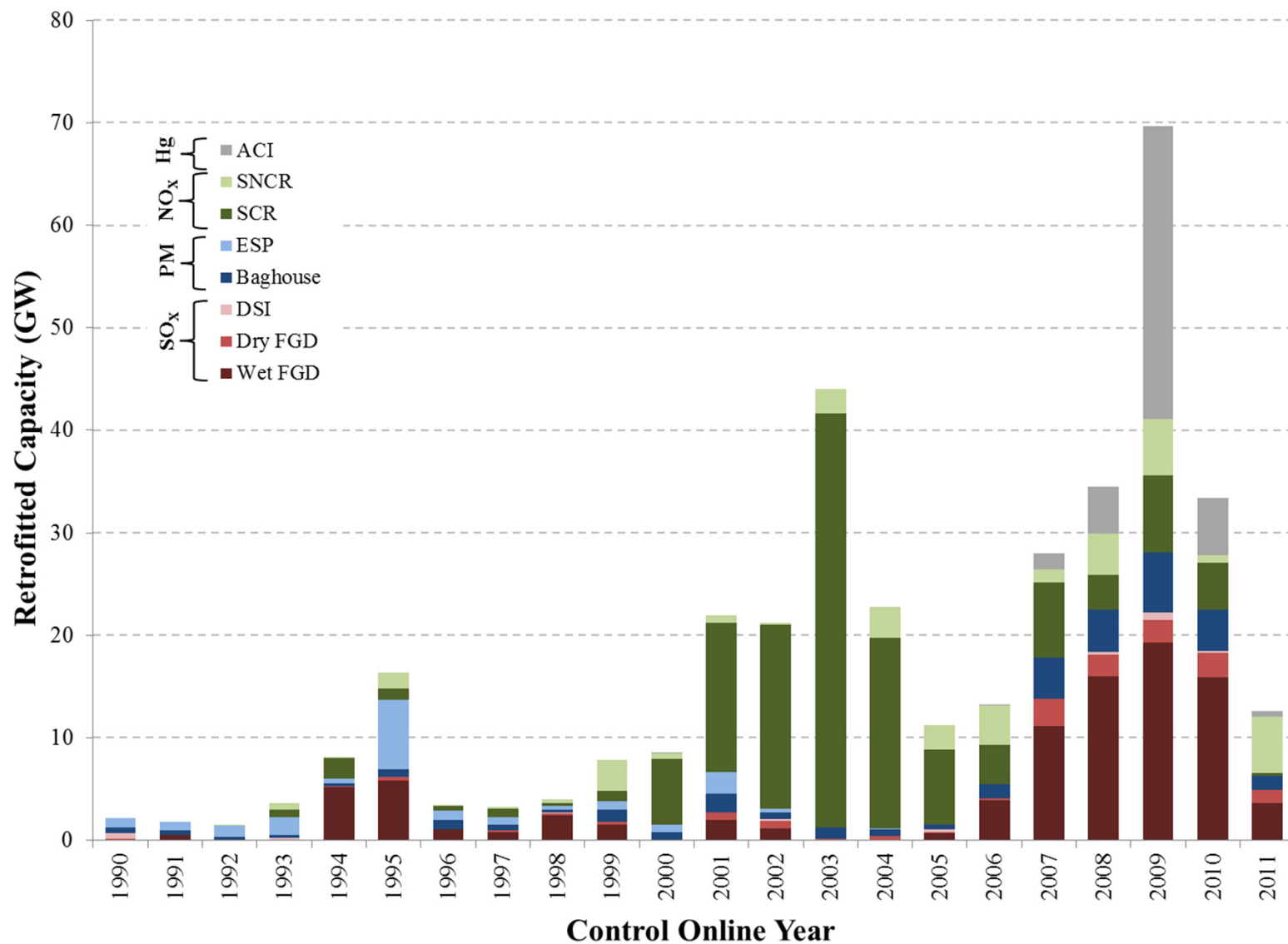
- ◆ Covers oil-fired and coal-fired power plants >25 MW
- ◆ All existing and new units must meet emissions standards for Hg, particulate matter (as a proxy for other heavy metals), and HCl (as a proxy for all toxic acid gases)

Retrofits Needed to Meet Standards

- ◆ Oil-fired units can generally comply without major upgrades (monitoring is required to confirm content of toxics is within standard)
- ◆ Coal-fired units will require a combination of controls (many partially controlled units will need to upgrade again)
- ◆ Unlike CSAPR, individual units must comply or retire (no cap-and-trade)
- ◆ Electric system operators and industry representatives stress the unprecedented scale and short timescale of needed retrofits and expected retirements

Mercury and Air Toxics Standards

Rule Comes after a Decade of Aggressive Retrofits



Unprecedented Retrofit and New Build Activity

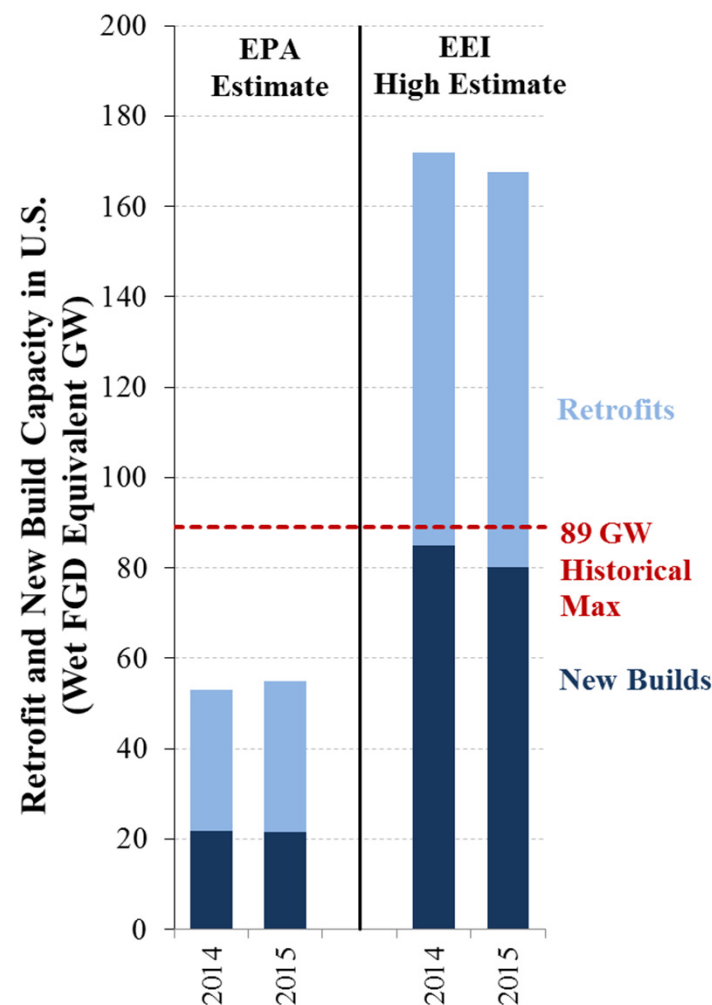
Supply Chain Study

- ◆ We conducted a supply chain study comparing total projected retrofit and new build activity compared to historical maximums
- ◆ Considered EPA and EEI projections of retrofit and new build activity imposed by MATS

Overall Outlook

- ◆ EPA estimates modest impact from MATS, indicating ample supply chain capability to meet requirements
- ◆ EEI estimates high MATS impact, which would exceed maximum historical activity by 90%

Projected Retrofits and New Build Compared to Historical Max



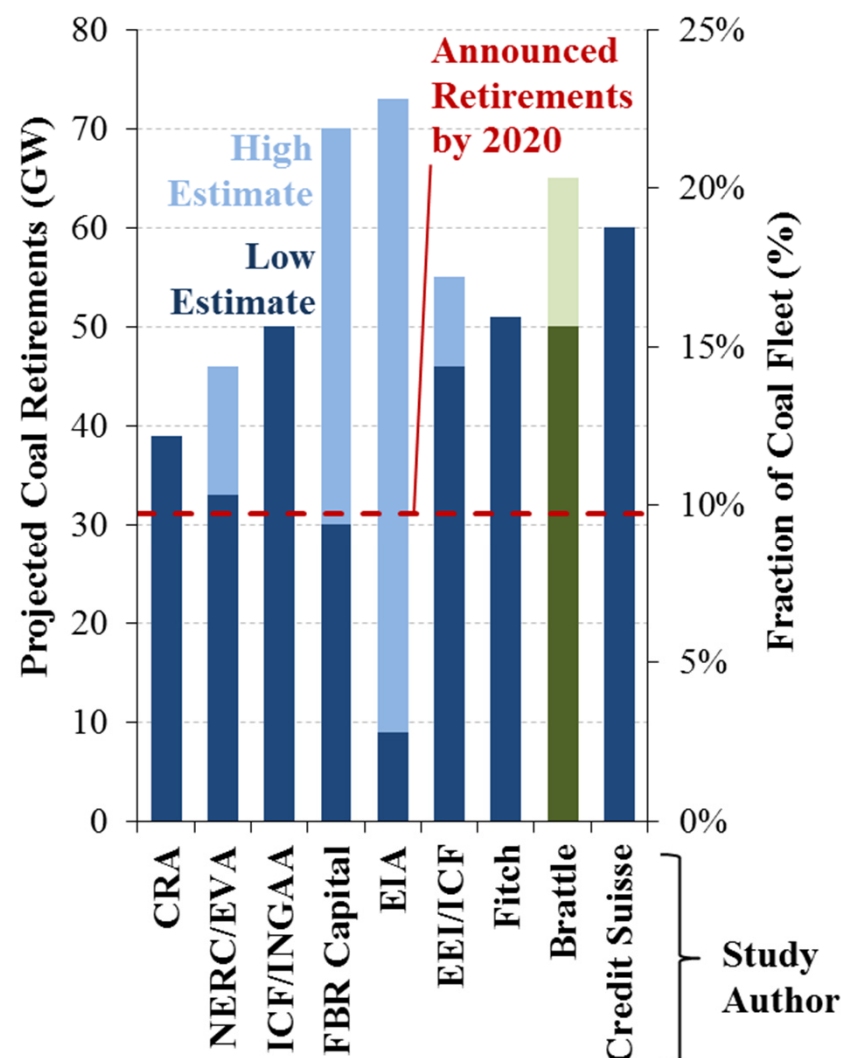
Potential Coal Retirement Impacts

Brattle Retirement Studies

- ◆ We have projected retirement impacts from MATS (and other upcoming EPA regs)
- ◆ Project market-based revenues against retrofit CapEx on a unit-specific basis

Overall Outlook

- ◆ 30 GW (10% of coal fleet) have already announced retirements (25 GW by 2015 MATS deadline)
- ◆ Expect 50-65 GW total (15-20% of fleet)



Evidence from PJM 2014/15 Capacity Auction

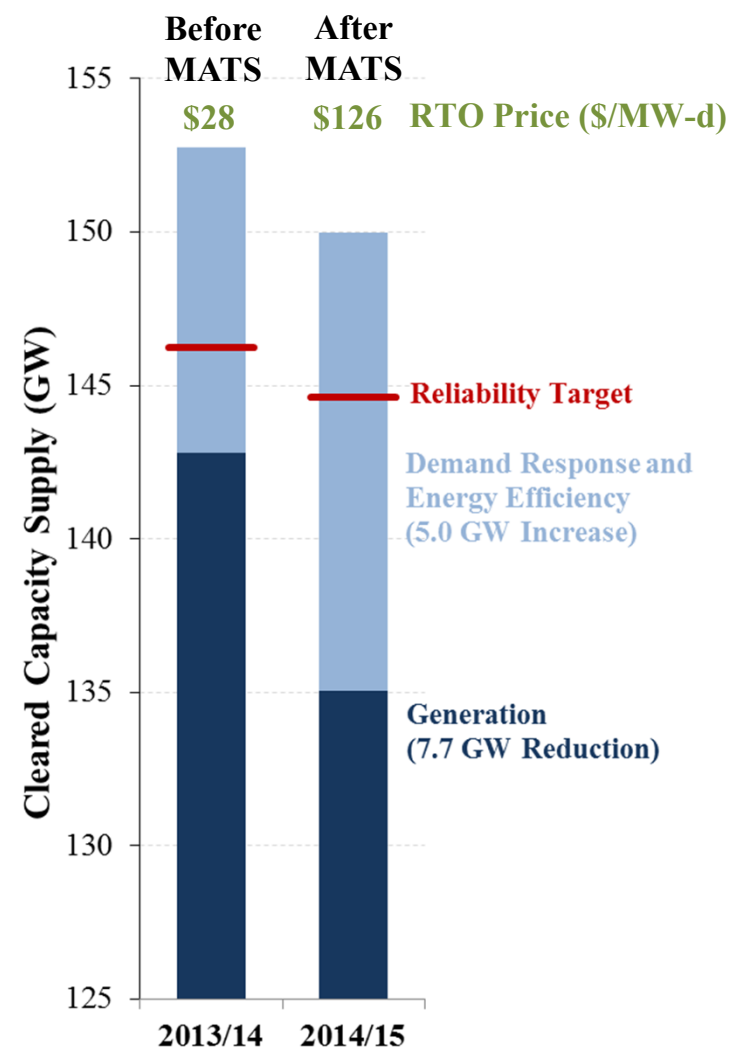
PJM Capacity Market

- ◆ 3-year forward market for generation and demand response
- ◆ Ensures sufficient capacity exists to meet load
- ◆ Retirement pressures will show up through decreased quantities and/or higher prices

PJM 2014/15 Auction

- ◆ MATS impact clear:
 - 8 GW less generation cleared (presumably most will retire)
 - Partly replaced by 5 GW of demand response
 - Prices increased 4 times (up from very low levels; prices still far below the cost of a new plant)
- ◆ 2015/16 auction results out next week

PJM Cleared Capacity



Source: PJM Base Residual Auction parameters and clearing results for 2013/14 and 2015/16.

About *The Brattle Group*

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies around the world.

We combine in-depth industry experience, rigorous analyses, and principled techniques to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

Our services to the electric power industry include:

Climate Change Policy and Planning

Cost of Capital

Demand Forecasting and Weather Normalization

Demand Response and Energy Efficiency

Electricity Market Modeling

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Transmission

Presenter Bio and Contact Information

Kathleen Spees is an associate of The Brattle Group with expertise in electric resource adequacy and capacity market design. Her project work for RTOs has included independent market design reviews and market design development related to resource adequacy in energy-only markets, capacity market design, and energy and capacity market seams. For market participants and regulators, she has developed market models for wholesale energy, capacity, and ancillary price projections; energy and ancillary dispatch; asset valuation; and coal fleet retirement risk analysis.

Kathleen earned a B.S. in Mechanical Engineering and Physics from Iowa State University. She earned an M.S. in Electrical and Computer Engineering and a Ph.D. in Engineering and Public Policy from Carnegie Mellon University.



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